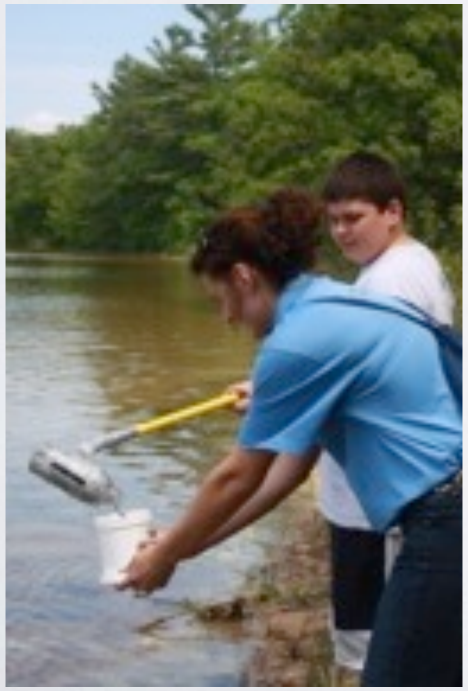
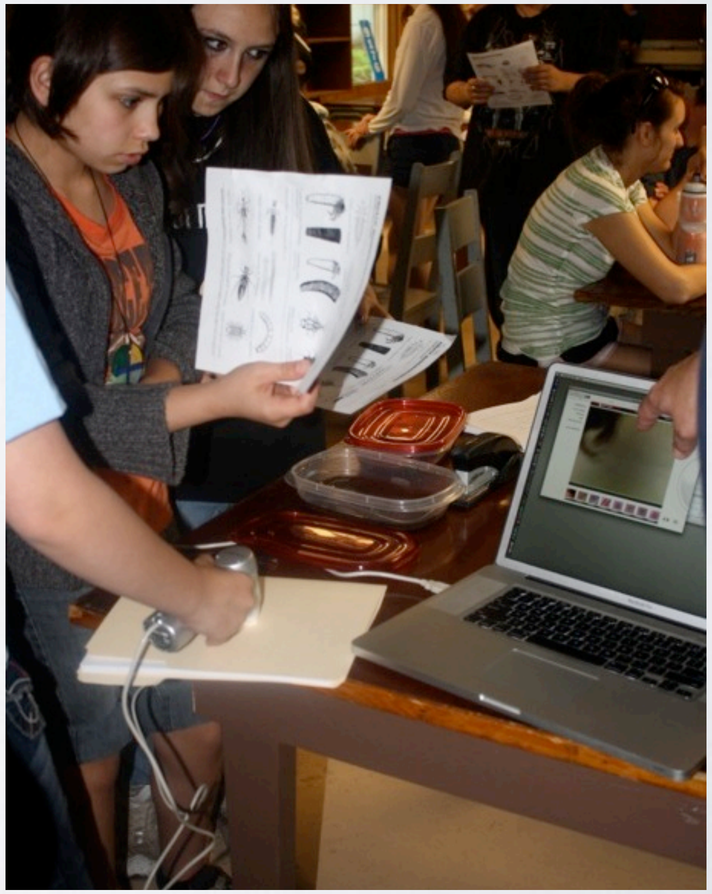
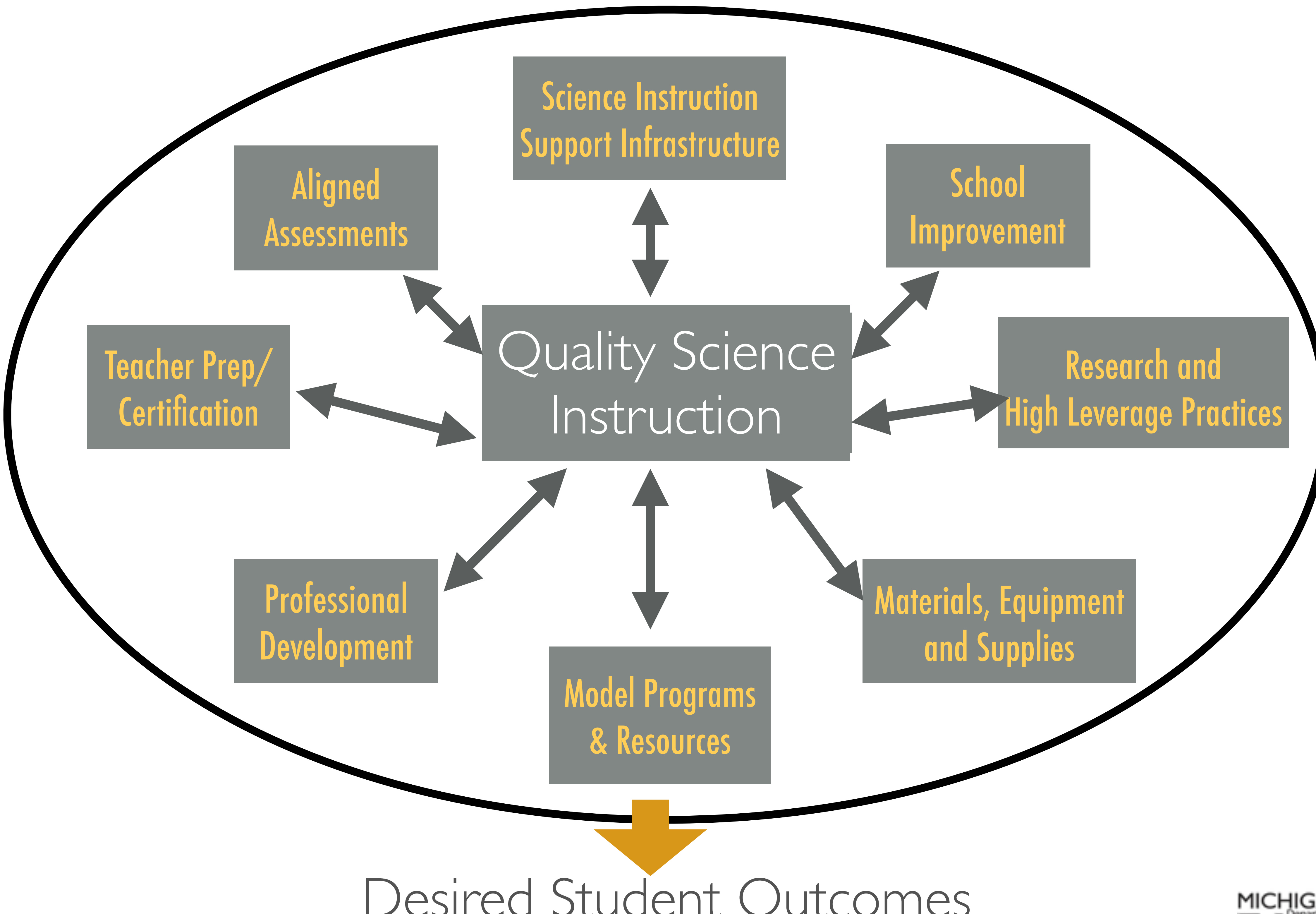
Michigan Science Standards





ACHIEVING THE VISION



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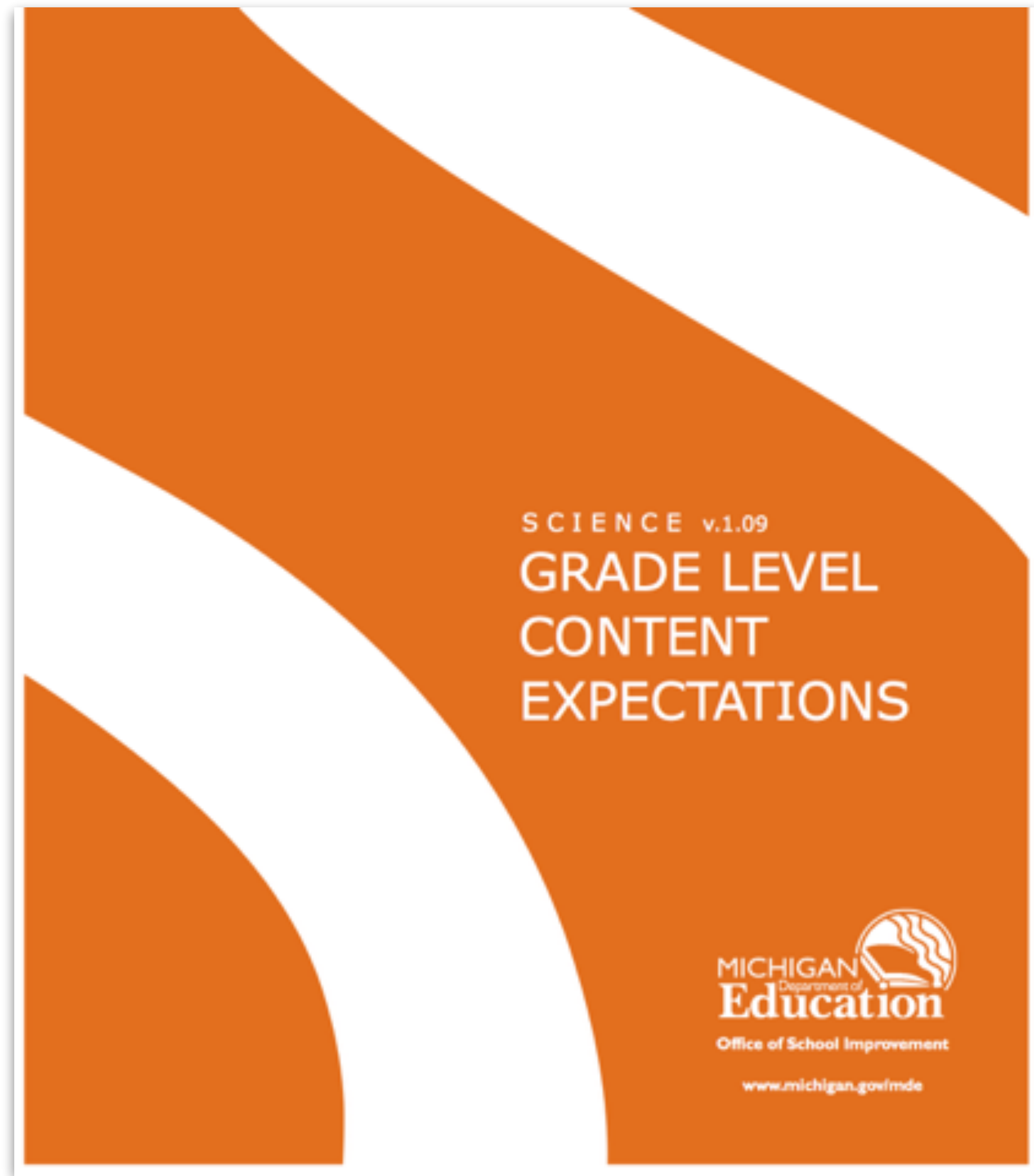
CURRENT STANDARDS

- Approved in 2006
- K-7 Grade Level Content Expectations (GLCEs) and High School Content Expectations (HSCEs)
- Followed by Companion Documents and topic-based mapping tools for support



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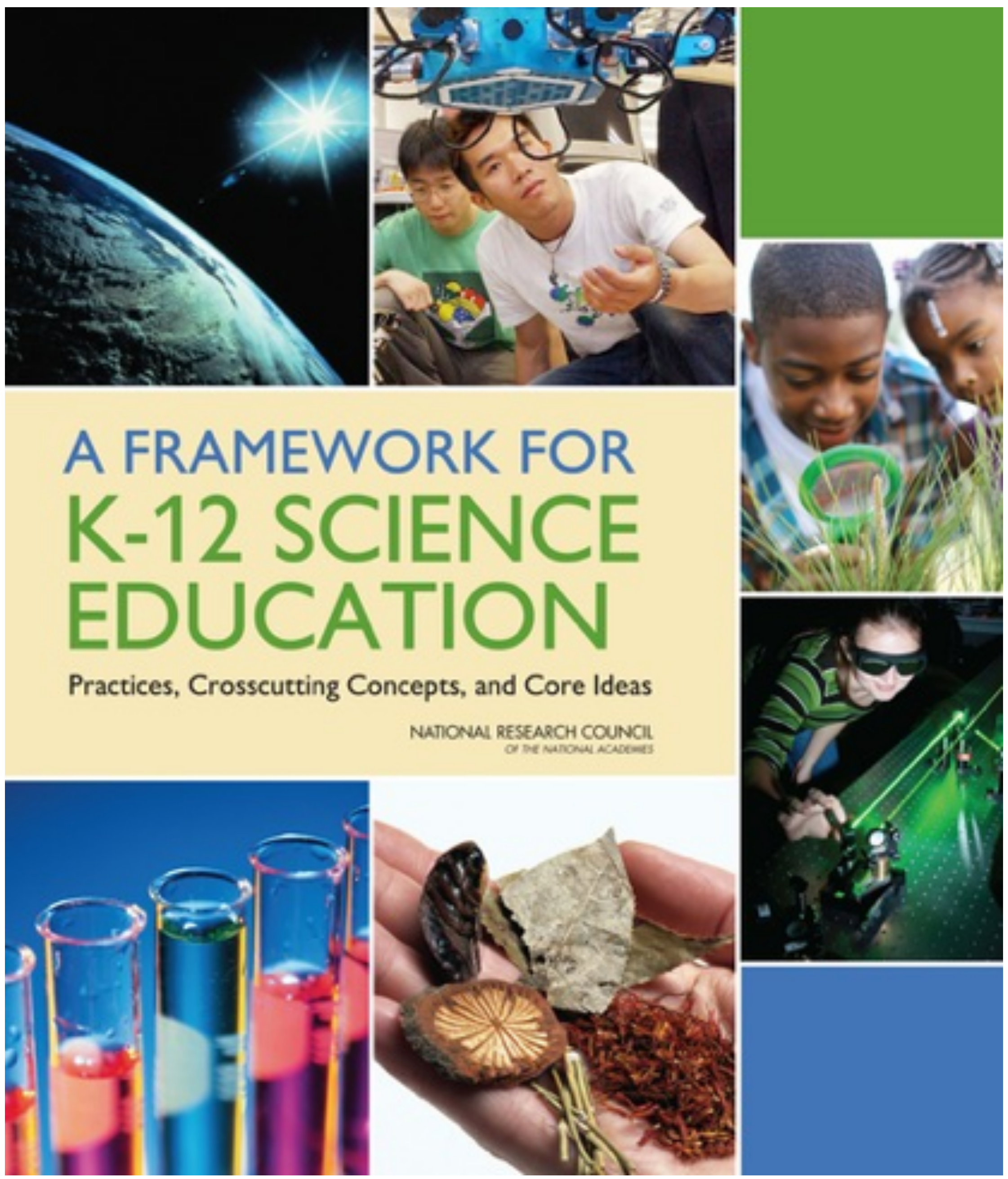
A RESEARCH-BASED TRANSITION



PRIMARY ISSUES:

- Incorporation of practices from the field
- No cross-cutting practices or integration
- Lack of understanding of learner needs

LEAD TO TRANSITION:

- Effort to restructure standards based on research findings and current landscape

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DEVELOPMENT EFFORT

- Michigan was one of 26 lead states involved in the development effort
- Several parties involved in science education in Michigan became partners in development and implementation
- Since publication, this has become the default resource and focus for Michigan science educators

Asking Questions and Defining Problems

Developing and Using Models

Planning and Carrying Out Investigations

Analyzing and Interpreting Data

Using Mathematics and Computational Thinking

Constructing Explanations and Designing Solutions

Engaging in Argument from Evidence

Obtaining, Evaluating, and Communicating Information

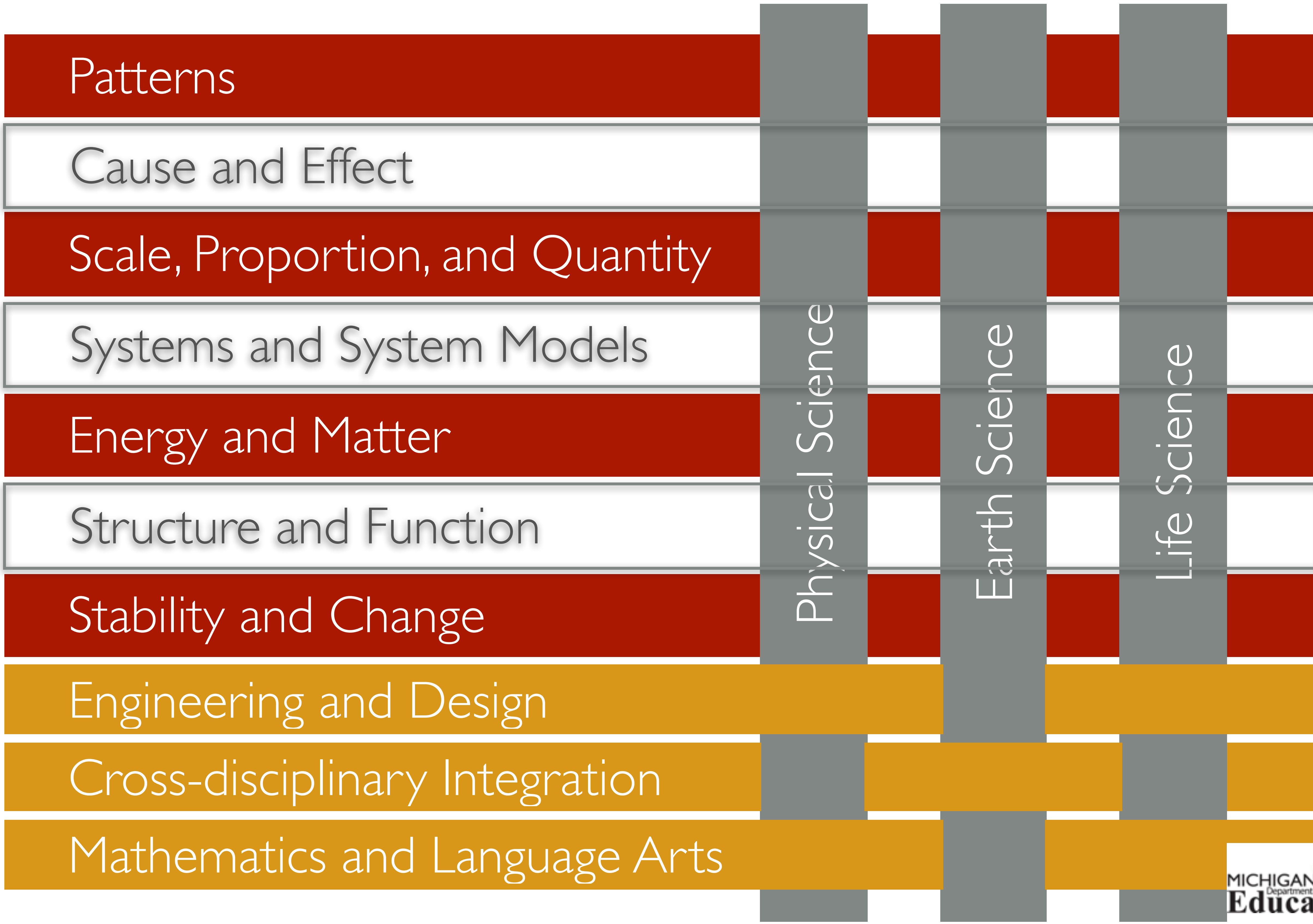
FOUNDATIONAL PRACTICES OF SCIENCE AND ENGINEERING

FOUNDATIONAL PRACTICES OF SCIENCE AND ENGINEERING

Physical Science

Earth Science

Life Science



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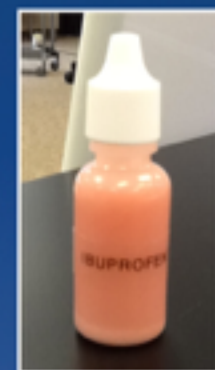
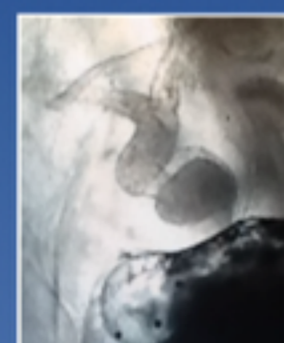
WHEN (AND HOW) DO WE START?

Question

How do three different types of painkillers affect the heart rate of the xenopus tadpole?

Observation





Ibuprofen Data Table

Trials	Culture Water	Ibuprofen	Qualitative Data/Notes
1	126 bpm	102 bpm	Very high heart rate
2	102 bpm	114 bpm	Great visual of heart beating
3	84 bpm	84 bpm	Could see blood flowing, hard to see heart
4	84 bpm	84 bpm	
5	72 bpm	78 bpm	Lower heart rate
6	90 bpm	84 bpm	Could see lungs great
7	90 bpm	90 bpm	
8	84 bpm	90 bpm	Could see blood flowing
9	84 bpm	96 bpm	Great visual of heart
10	90 bpm	90 bpm	No change
Average	90.6	91.2	

WHAT DO WE SEE FROM STUDENTS?

- Predictions
- Sources of Error
- Confidence in results
- Future questions to investigate

Claim: I claim that when introduced to the xenopus tadpole, these painkillers will most likely make the heart rate go up, or it will stay the same, but rarely go down.

Evidence: Almost all of my trials support my claim; they all either stayed the same, or went up. For the example 24/30 trials either went up or stayed the same, and the average of all the trials is 87.2 in water, and 91.8 when the painkiller is introduced.

Reasoning: I did ten trials for each type of medicine, so my investigation was a fair test, and I looked for all potential sources of error, and if there was one, I restarted, so I am strongly confident in my investigation. I had also known from second hand research that these medicines had no known stimulants or depressants, so it wouldn't make much of a difference.

CONNECTING SCIENTIFIC PRACTICES WITH MATH AND ELA SKILLS

Driving Question:
What is the water like in our river?

HOW DO WE ENGAGE LEARNERS AND DEEPEN UNDERSTANDING?

Driving Question:
What is the water like in our river?

Where does the water in our river come from?

What happens when it rains?

How does the water get to the river?

Who depends on the water?

Is the water different through the river?

What is in the water in our river?

What lives in the river?

Is our river different from others?

Can we drink the water?

HOW DO WE ENGAGE LEARNERS AND DEEPEN UNDERSTANDING?

Standards Comparison: Structure and Properties of Matter

Students who demonstrate understanding can:

Current

a. **Classify** substances by their chemical properties (flammability, pH, and reactivity).
b. **Identify** the smallest component that makes up an element.
c. **Describe** how the elements within the Periodic Table are organized by similar properties into families (highly reactive metals, less reactive metals, highly reactive nonmetals, and some almost completely non-reactive gases).
d. **Illustrate** the structure of molecules using models or drawings (water, carbon dioxide, table salt).
e. **Describe** examples of physical and chemical properties of elements and compounds (boiling point, density, color, conductivity, reactivity).

Proposed:

1. **Develop models to describe** the atomic composition of simple molecules and extended structures.
2. **Analyze and interpret data** on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
3. **Gather and make sense of information to describe** that synthetic materials come from natural resources and impact society.
4. **Develop a model that predicts and describes** changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.
5. **Develop and use a model to describe** how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
6. **Undertake a design project to construct, test, and modify a device** that either releases or absorbs thermal energy by chemical processes.*

A REVIEW OF STANDARDS…

MDE / Wayne RESA contract with SRI International:

- External, independent content comparison review
- Michigan Science Standards (GLCE and HSCE) to Next Generation Science Standards

Methodology:

- Crosswalk framework
- Content analysis for similarities and differences

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SRI RECOMMENDATIONS AND RATIONALES

Recommendations	Rationales
Michigan should consider the adoption of the NGSS performance expectations in order to improve science education in all grades.	The value added by the adoption of the NGSS includes access to current science concepts that are required to prepare students for college and careers.
The NGSS Science and Engineering Practices and Crosscutting Concepts should be implemented to enhance current science education instruction for grades K-12.	The NGSS Science and Engineering Practices and Crosscutting Concepts are embedded across the NGSS performance expectations and provide coherence across grades and all science disciplines.
The NGSS performance expectations for the Disciplinary Core Ideas in Engineering, Technology and Application of Science contain new content that should be included in science instruction across all grades.	Implementation of the NGSS performance expectations in new content areas such as Engineering, Technology and the Application of Science will prepare students for solving future and current societal problems.
The NGSS performance expectations provide explicit connections to Common Core Mathematics and English Language Arts Standards that should be integrated into science instruction.	The NGSS linkages to the Common Core Standards for Mathematics and English Language Arts connect consistent performance expectations across core content areas.
NGSS Professional Development Resources that support instruction in new content areas are available through participation in the NGSS Network and should be leveraged to support Michigan science teachers.	On-going, high quality professional development that includes current science concepts is essential to improvements in science instruction.

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MICHIGAN SCIENCE STANDARDS

For Adoption:

- **Student Performance Expectations** (and relevant NGSS coding), including Michigan specific expectations where appropriate
- **Front matter describing** ***Crosscutting Concepts*** (organizational frame), ***Science and Engineering Practices*** (integrated into performance expectations), and ***Disciplinary Core Ideas***

Not for Adoption

- Guidance Materials on Instruction and Assessment
- Ancillary Materials (Appendices, Models, Crosswalks, etc.)

WHY?:

- Offer greater flexibility for local implementation in Michigan's school districts and public school academies

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PROPOSED SCIENCE STANDARDS & GUIDANCE

4th Grade

1

Earth's Systems: Processes that Shape the Earth

4-ESS1-1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. **

4-ESS1-1 MI Identify evidence from patterns in rock formations and fossils in rock layers to support possible explanations of Michigan's geological changes over time.

4-ESS2-1 Make observations and/or measurements to provide evidence of the effects of weathering or the rate of erosion by water, ice, wind, or vegetation**

4-ESS2-2 Analyze and interpret data from maps to describe patterns of Earth's features.

4-ESS3-2 Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans. * **

4-ESS3-2 MI Generate and compare multiple solutions to reduce the impacts of natural Earth processes on Michigan's people and places.

DRAFT

Engineering Design

3-5-ETS1-1 Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

* - Integrates traditional science content with engineering. - Includes a Michigan specific performance expectation.
**- Allow for local, regional, or Michigan specific contexts or examples in teaching and assessment.

1. Organized by grade level or band and content strand

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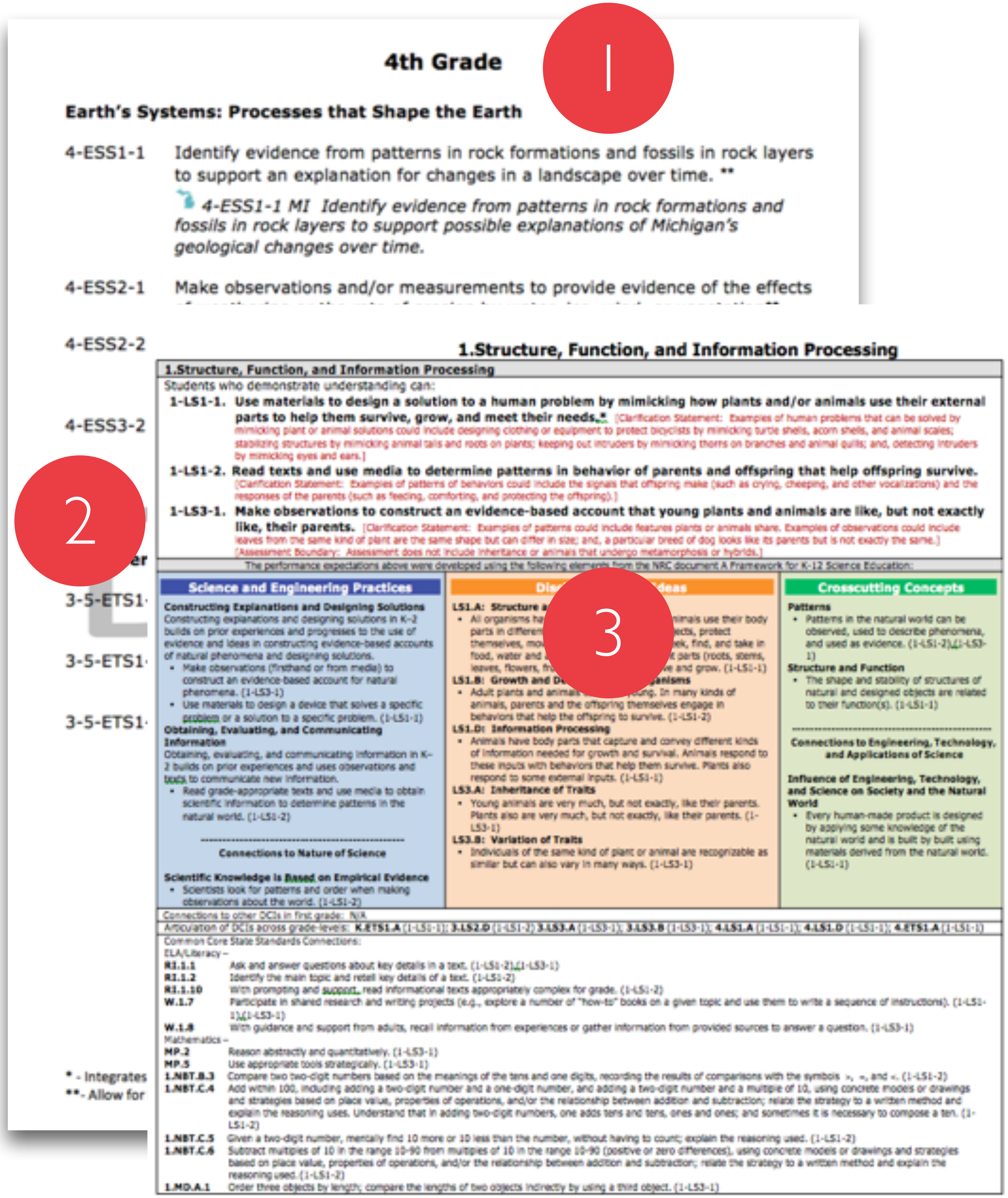
2. Performance expectations include coding, and MI-specific alternatives

PROPOSED SCIENCE STANDARDS & GUIDANCE



1. Organized by grade level or band and content strand

2. Performance expectations include coding, and MI-specific alternatives

3. Guidance organized in same manner, but includes relevant Science and Engineering Practice, Disciplinary Core Ideas, and Crosscutting Concepts)

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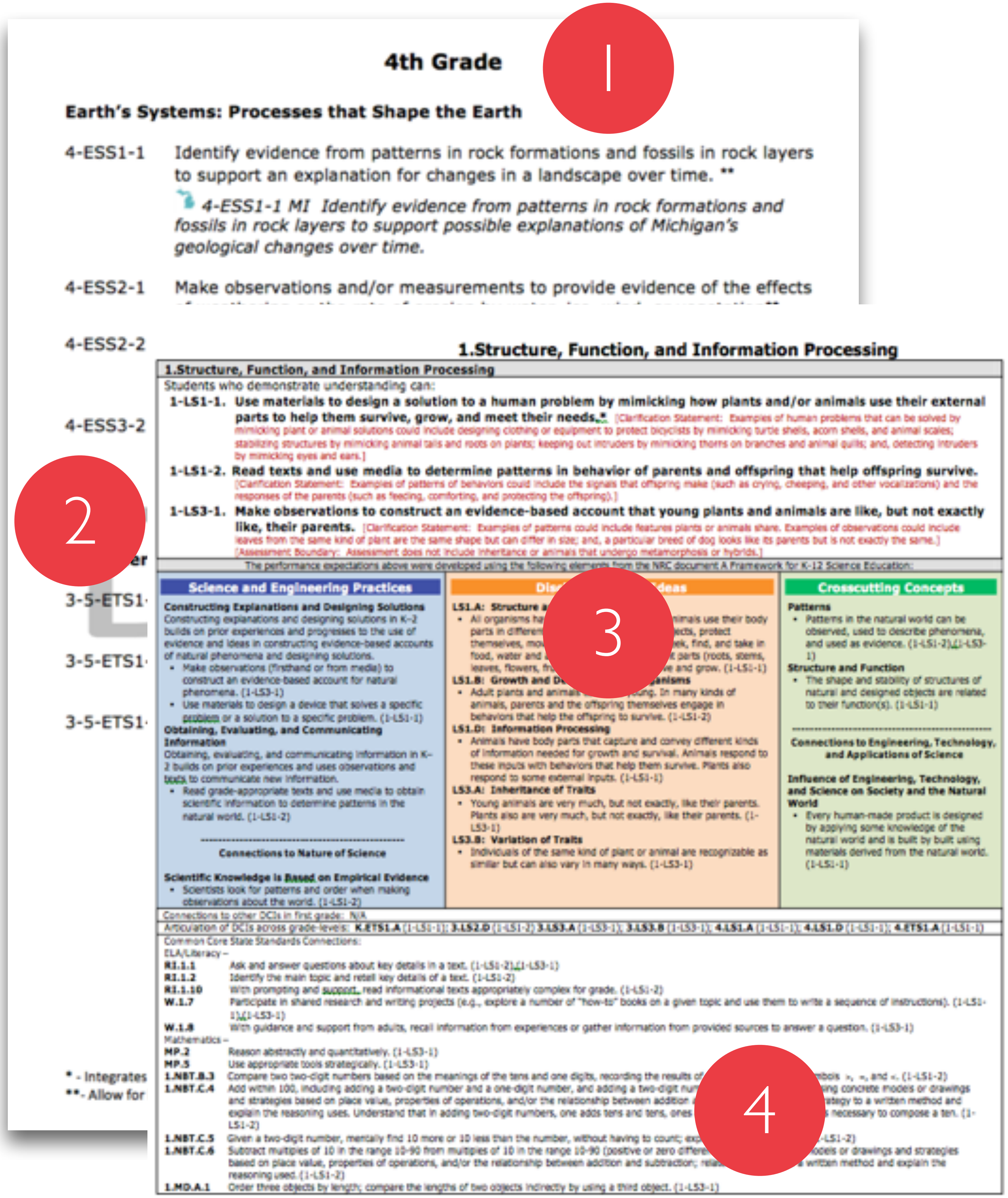
PROPOSED SCIENCE STANDARDS & GUIDANCE



1. Organized by grade level or band and content strand
2. Performance expectations include coding, and MI-specific alternatives
3. Guidance organized in same manner, but includes relevant Science and Engineering Practice, Disciplinary Core Ideas, and Crosscutting Concepts)
4. Guidance also includes relevant assessment boundaries, contexts, and related standards

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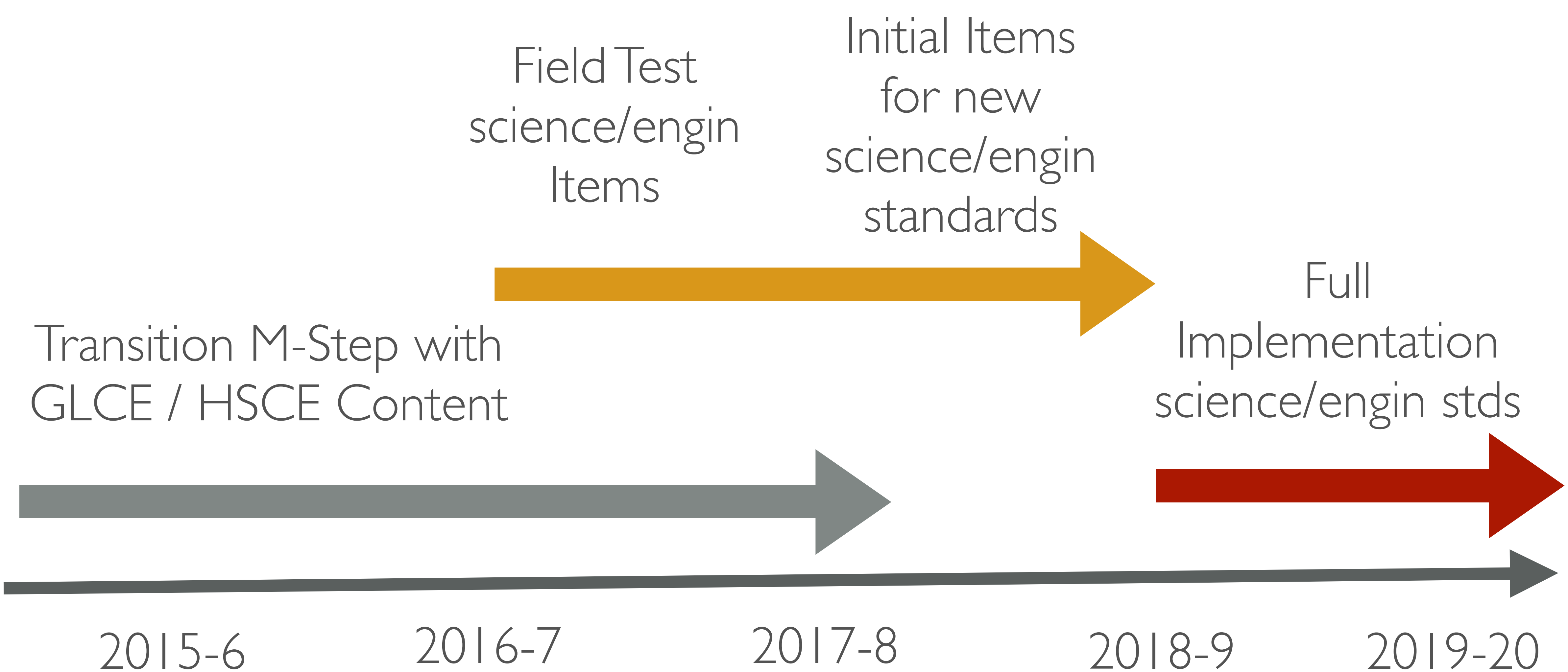
NEXT STEPS - ASSESSMENT

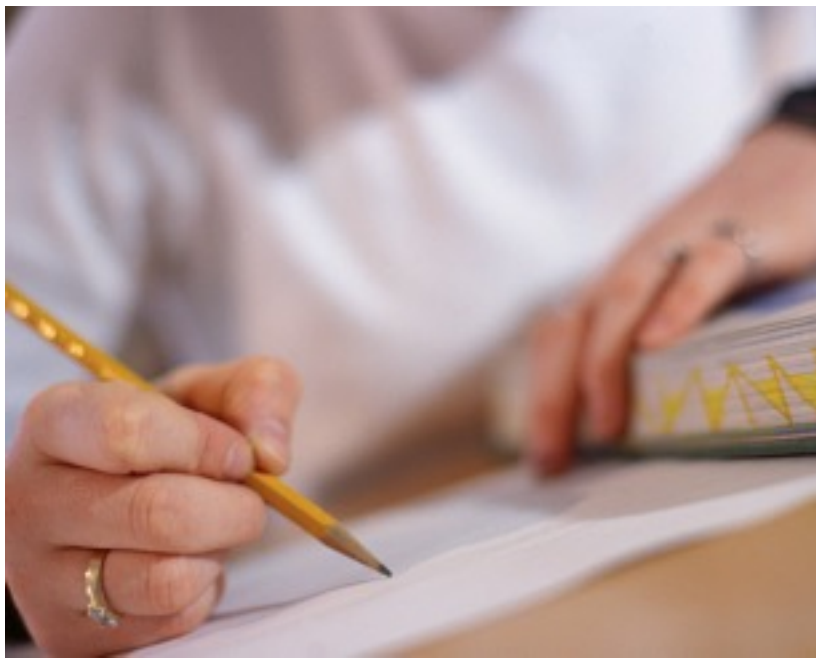
State and Local Assessments

Formative Assessments

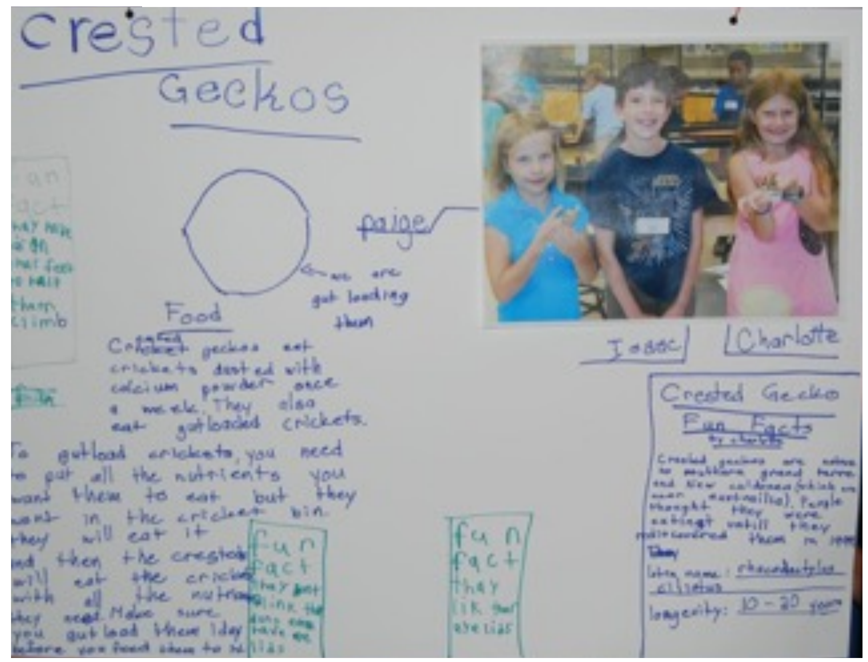
SCIENCE ASSESSMENT TIMELINE



CLASSROOM AND SCHOOL ASSESSMENTS FOR SCIENCE



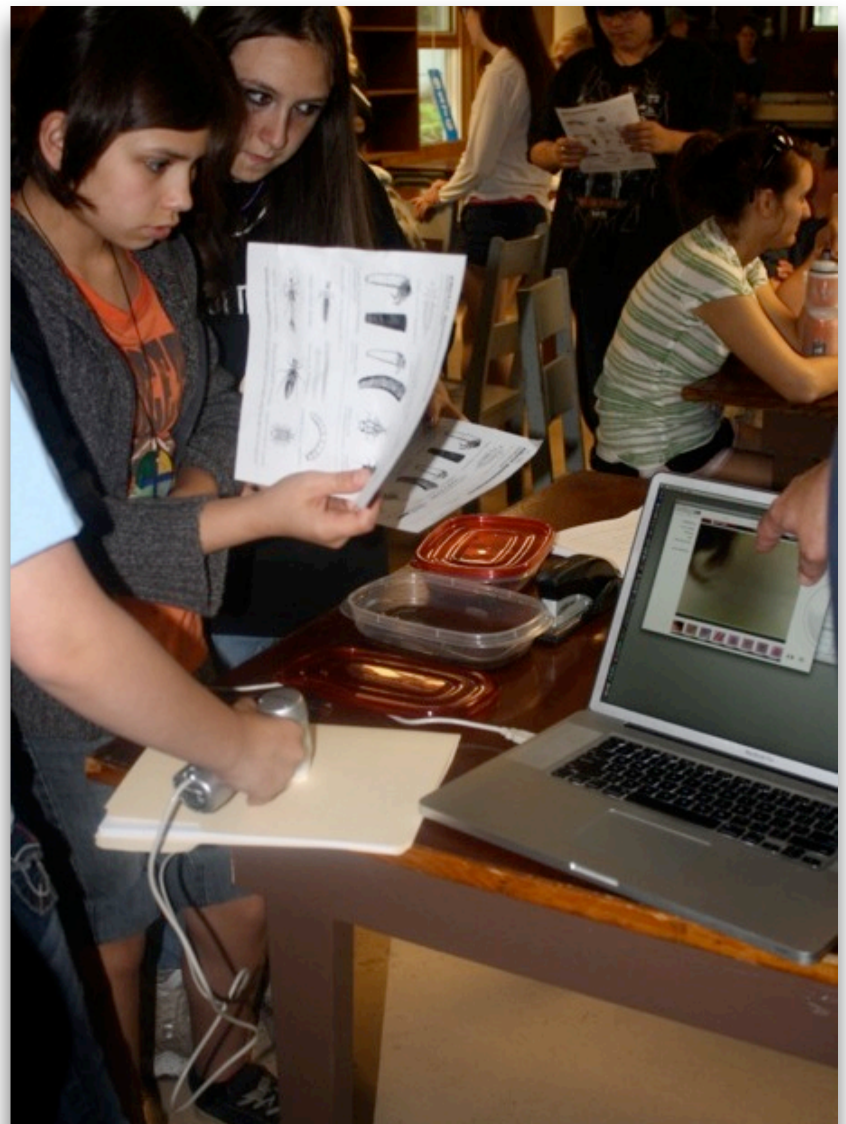
Common local assessments



Analysis of student artifacts

Performance assessment

NEXT STEPS - SCHOOL POLICY



Resources for Learning

Instructional Practice

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TRANSITION TIMELINE